

What is claimed is:

1. A system for verifying the purported identity of a target individual comprising:

an enrollment database including tissue optical spectral data collected from at least one enrolled persons, said enrolled persons optical spectral data having a plurality of measurement values;

means for obtaining at least one tissue optical spectral data and purported identity from said target individual, said target individual's optical spectral data having a plurality of measurement values;

means for comparing said target individual optical spectral data and said enrolled persons optical spectral data, said enrolled person optical spectra corresponding to the purported identity of the target individual, said comparison providing a measure of the degree of similarity between said target optical spectral data and said enrolled person's spectral data; and

means for positively verifying said target individual's identity by confirming that said target individual's measure of spectral similarity is at least as similar as an established threshold value.

2. The system as recited in claim 1, wherein said means for obtaining said target individual spectral data includes means for measuring optical radiation reflected from sub-epidermal tissue of said target individual.

3. The system as recited in claim 1, wherein said means for obtaining said target optical spectral data includes a spectrometer.

4. The system as recited in claim 3, wherein said spectrometer is an FTIR spectrometer.

5. The system as recited in claim 3, wherein said spectrometer is a grating array spectrometer.

6. The system as recited in claim 1, wherein said optical spectral data include near-infrared wavelengths.

7. The system as recited in claim 1, wherein said optical spectral data include visible wavelengths.

8. The system as recited in claim 1, wherein said optical spectral data include near-ultraviolet wavelengths.

9. The system as recited in claim 1, wherein said comparison and similarity determination utilizes a classification algorithm.

10. A system for identifying a target individual comprising:
an enrollment database including tissue optical spectral data collected from one or
more enrolled persons, said enrolled persons optical spectral data having a plurality of
measurement values;
means for obtaining at least one tissue optical spectral data from said target
individual, said target individual's optical spectral data having a plurality of measurement
values;
means for comparing said target individual optical spectral data and said all
enrolled persons optical spectral data, said comparison providing a measure of the degree
of similarity between said target optical spectral data and said enrolled persons
spectral data; and
means for indicating identity as at least one of the said enrolled persons if the
corresponding measure of degree of similarity is at least as similar as an established
threshold value.

11. The system as recited in claim 10, wherein said means for obtaining said
target individual spectral data includes means for measuring optical radiation reflected
from sub-epidermal tissue of said target individual.

12. The system as recited in claim 10, wherein said means for obtaining said
target optical spectral data includes a spectrometer.

13. The system as recited in claim 12, wherein said spectrometer is an FTIR spectrometer.

14. The system as recited in claim 12, wherein said spectrometer is a grating array spectrometer.

15. The system as recited in claim 10, wherein said optical spectral data include near-infrared wavelengths.

16. The system as recited in claim 10, wherein said optical spectral data include visible wavelengths.

17. The system as recited in claim 10, wherein said optical spectral data include near-ultraviolet wavelengths.

18. The system as recited in claim 10, wherein said comparison and similarity determination utilizes a classification algorithm.

19. A system for verifying the purported identity of a target individual comprising:

a computer including an input device and an output device;
an enrollment database including tissue optical spectra for at least one enrolled persons;

means for obtaining at least one tissue optical spectrum from said target individual, including an optical radiation source, an optical sampler for projecting optical radiation into the tissue and for collecting radiation that substantially passed through sub-epidermal tissue, an optical spectrometer for measuring the sub-epidermal optical intensity over a plurality of wavelengths;

means for obtaining said target individual's purported identity; and
a program running in said computer for comparing said target individual optical spectra and said enrolled persons optical spectra corresponding to said target individual's purported identity.

20. A system for identifying a target individual comprising:
a computer including an input device and an output device;
an enrollment database including tissue optical spectra for at least one enrolled persons;

means for obtaining at least one tissue optical spectrum from said target individual, including an optical radiation source, an optical sampler for projecting optical radiation into the tissue and for collecting radiation that substantially passed through sub-epidermal tissue, an optical spectrometer for measuring the sub-epidermal optical intensity over a plurality of wavelengths; and

a program running in said computer for comparing said target individual optical spectra and all said enrolled persons optical spectra.

21. A method for verifying the purported identity of a target individual utilizing an enrollment database including tissue optical spectra collected from a number of enrolled individuals having known identities, said spectral data having a plurality of measurement wavelengths, comprising the steps of:

obtaining target tissue spectral data from said target individual, said target tissue spectral data having a number of measurement wavelengths;

obtaining said purported identity from said target individual;

comparing said target individual optical spectral data and said enrolled person's optical spectral data, said enrolled person's optical spectra corresponding to the purported identity of the target individual, said comparison providing a measure of the degree of similarity between said target optical spectral data and said enrolled person's spectral data; and

positively verifying said target individual's identity by confirming that said target individual's measure of spectral similarity is at least as similar as an established threshold value.

22. The method for verifying the identity of a target individual as recited in claim 21, wherein the method further includes a classification algorithm to perform said comparison between said target individual's optical spectral data and said enrolled person's optical spectral data.

23. The method for verifying the identity of a target individual as recited in
claim 22, wherein the method further includes classification features that are determined
from a set of calibration optical spectral data collected on at least one individual
measured more than one time.

24. The method for verifying the identity of a target individual as recited in
claim 23, wherein said classification features are applied to the said comparison between
the target optical spectral data and the enrollment spectral data to determine the similarity
with respect to the said classification features.

25. The method for verifying the identity of a target individual as recited in
claim 24, wherein said verification occurs when said comparison of said target optical
spectral data and said enrollment spectral data using said classification features is at least
as good a predetermined measure of similarity.

26. The method for identifying a target individual as recited in claim 24,¹⁹
further comprising an enrollment database with optical spectral data collected from a
number of enrolled individuals, wherein said number is greater than one.

27. The method for identifying a target individual as recited in claim 24,¹⁹
further comprising an enrollment database with optical spectral data collected from a
number of enrolled individuals, wherein said number is equal to one.

28. The method for identifying a target individual as recited in claim 21, wherein said target spectrum is added to said enrollment optical spectral data after said verification of identity.

29. The method for identifying a target individual as recited in claim 21, wherein said tissue optical spectra include near-ultraviolet wavelengths.

30. The method for identifying a target individual as recited in claim 21, wherein said tissue optical spectra include visible wavelengths.

31. The method for identifying a target individual as recited in claim 21, wherein said tissue optical spectra include near-infrared wavelengths.

32. The method for identifying a target individual as recited in claim 21, wherein said tissue spectra ~~includes~~ a substantial spectra contribution from sub-epidermal tissue.

33. A method for identifying a target individual utilizing an enrollment database including tissue optical spectra collected from a number of enrolled individuals, said spectral data having a plurality of measurement wavelengths, comprising the steps of:

obtaining target tissue spectral data from said target individual, said target tissue optical spectral data having a number of measurement wavelengths;

comparing said target individual optical spectral data and said enrolled person's optical spectral data, said comparison providing a measure of the degree of similarity between said target optical spectral data and each of said enrolled person's spectral data; and

positively establishing said target individual's identity by confirming that said target individual's measure of spectral similarity is at least as similar to one of the enrolled person's optical spectral data as an established threshold value.

34. The method for identifying a target individual as recited in claim 33, wherein the method further includes a classification algorithm to perform said comparison between said target individual's optical spectral data and said enrolled persons optical spectral data.

35. The method for identifying a target individual as recited in claim 34, wherein the method further includes classification features that are determined from a set of calibration optical spectral data collected on at least one individual measured more than one time.

36. The method for identifying a target individual as recited in claim 35, wherein said classification features are applied to the said comparison between the target optical spectral data and the enrollment spectral data to determine the similarity with respect to the said classification features.

500 C107 37. The method for identifying a target individual as recited in claim 36, wherein said identification occurs when said comparison of said target optical spectral data and said enrollment spectral data using said classification features is at least as similar as a predetermined measure of similarity for a number of enrolled persons optical spectral data.

20 38. The method for identifying a target individual as recited in claim *37*, wherein the target identity is chosen as the most similar of all said enrolled persons whose enrollment spectral data are at least as similar to the said target spectral data as a predetermined measure of similarity.

500 C11 39. The method for identifying a target individual as recited in claim 33, further comprising an enrollment database with optical spectral data collected from a number of enrolled individuals, wherein said number is greater than one.

40. The method for identifying a target individual as recited in claim 33, further comprising an enrollment database with optical spectral data collected from a number of enrolled individuals, wherein said number is equal to one.

28 41. The method for identifying a target individual as recited in claim *33*, wherein said target spectrum is added to said enrollment optical spectral data after said identification.

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42. The method for identifying a target individual as recited in claim 33, wherein said tissue optical spectra include near-ultraviolet wavelengths.

43. The method for identifying a target individual as recited in claim 33, wherein said tissue optical spectra include visible wavelengths.

44. The method for identifying a target individual as recited in claim 33, wherein said tissue optical spectra include near-infrared wavelengths.

45. The method for identifying a target individual as recited in claim 33, wherein said tissue spectra include a substantial spectra contribution from sub-epidermal tissue.

46. A method for verifying the identity of a target individual comprising the steps of:

obtaining a number of enrollment optical tissue spectra from a number of individuals, said enrollment tissue optical spectra having a plurality of measurement wavelengths, said enrolled tissue optical spectra corresponding to said enrolled individual's identities;

obtaining a target tissue spectrum from said target individual, said target tissue spectrum having a number of measurement wavelengths;

obtaining an identifier from said target individual;

selecting said enrolled optical spectral data that corresponds to said target

individual's identifier;

performing discriminant analysis on said target tissue spectrum and said enrolled tissue spectral data corresponding to said identifier; and

positively verifying said target identity if, and only if, said discriminant analysis is satisfied.

47 A method for identifying a target individual comprising the steps of:

obtaining a number of enrollment optical tissue spectra from a number of individuals, said enrollment tissue optical spectra having a plurality of measurement wavelengths:

obtaining a target tissue spectrum from said target individual, said target tissue spectrum having a number of measurement wavelengths;

performing discriminant analysis on said target tissue spectrum and all of said enrolled tissue spectral data; and

positively identifying said target identity if, and only if, said discriminant analysis is satisfied for at least one of said enrolled persons optical spectral data.

48. A method for performing a biometric task comprising the steps of:

measuring the spectral properties of the sub-epidermal tissue at at least one site selected from the group consisting of the dorsal and ventral surfaces of the proximal phalanges of any finger or thumb, the dorsal and ventral surfaces of the medial phalanges of any finger, the dorsal and ventral surfaces of the distal phalanges of any finger or thumb, the dorsal and ventral surfaces of the wrist, the web between the index finger and

thumb, the thenar eminence, the hypotenar eminence, and the medial hypotenar eminence; and

applying an algorithm to said spectral properties to perform a biometric task.

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